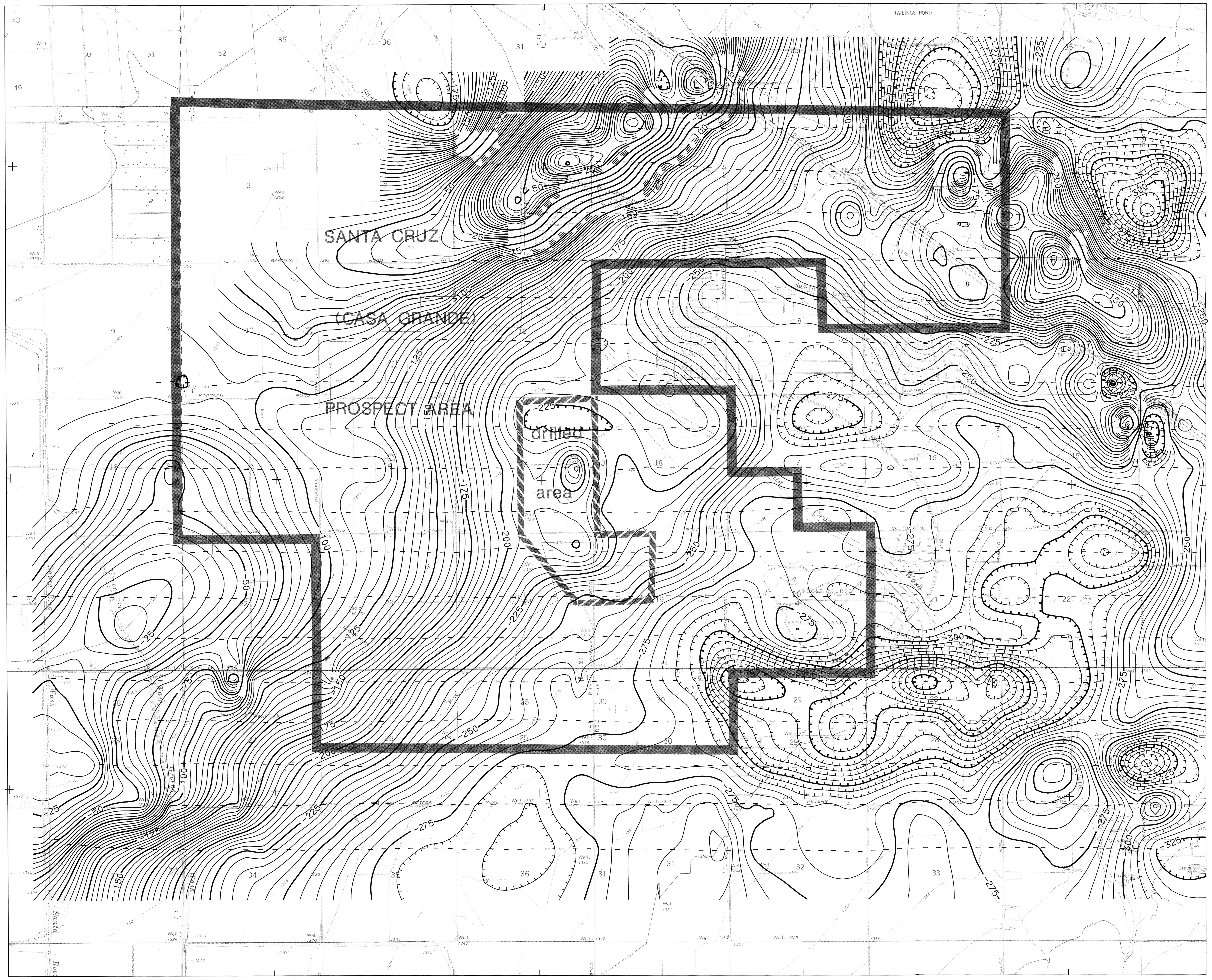

Base from U.S. Geological Survey
Casa Grande West, Chuichu,
Double Peak, and Stanfield,
1:24,000, 1965

SCALE 1:24 000

CONTOUR INTERVAL 5 AND 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Manuscript approved for publication,
September 24, 1991

MAP A.--CASA GRANDE MAGNETIC ANOMALY MAP AT 300 FEET (91 METERS) ABOVE TERRAIN. FLIGHT LINES ARE APPROXIMATELY 0.25 MILES (0.4 KILOMETERS) APART

AEROMAGNETIC MAPS OF A BURIED PORPHYRY COPPER DEPOSIT WEST OF CASA GRANDE, ARIZONA

By
Viki Bankey
1992

EXPLANATION

Aeromagnetic contours--Number shows total intensity anomaly (with IGRF removed) in nanoTeslas; hachured where contour encloses a low; contour interval 5 nT

Flight line location

Boundary of prospect study area

Boundary of drilled area

INTRODUCTION

The Casa Grande deposit (also known as the Santa Cruz deposit) is a buried porphyry copper deposit 7 mi (11 km) west of the city of Casa Grande, Arizona. The prospect has been drilled at close spacing and ore was discovered between 1,000 and 2,000 ft (305 and 610 m) below the surface in host rock consisting of Laramide porphyry intruded into Middle Proterozoic Oracle Granite. Diabase and other mafic dikes intrude the host rock. Cummings (1982) suggested that the deposit is similar to the Sacaton porphyry copper deposit located 6 mi (10 km) northeast, because both deposits are buried beneath alluvial cover and, unlike most porphyry copper deposits, have intruded a host rock that consists of both Precambrian granite and Laramide intrusive rock. Cummings concluded that the Sacaton and Casa Grande deposits may have been parts of a single hydrothermal system that was later separated by faulting. The Casa Grande deposit lies along the extension of a structural lineament called the Jemez zone that trends northeast from Sacaton through Globe, Arizona, and into New Mexico (Mayo, 1958).

Companies developing the deposit have proposed the leaching of the buried ore in place. The U.S. Geological Survey (USGS) and the U.S. Bureau of Mines are studying the geology and hydrology of the area to evaluate the environmental impact of the leaching technique and to prepare an ore-deposit model.

DATA COLLECTION

In support of the study, the USGS has recently flown two aeromagnetic surveys over the Casa Grande deposit: one flown north-south, 600 ft (183 m) above terrain, at 1/2-mi (.8-km) spacing, and the other flown east-west, 300 ft (91 m) above terrain, at 1/4-mi (.4-km) spacing. The gridded data are available on 5 1/4-in. diskette (Bankey and others, 1990). The area covered is shown in figure 1. An earlier survey was flown in 1963 (Mitchell and Zandle, 1965) at a spacing of 1 mi (.73 km) and a flight elevation of .33 mi (.53 km) barometric. This survey is inadequate to resolve anomalies of the size and magnitude of our study.

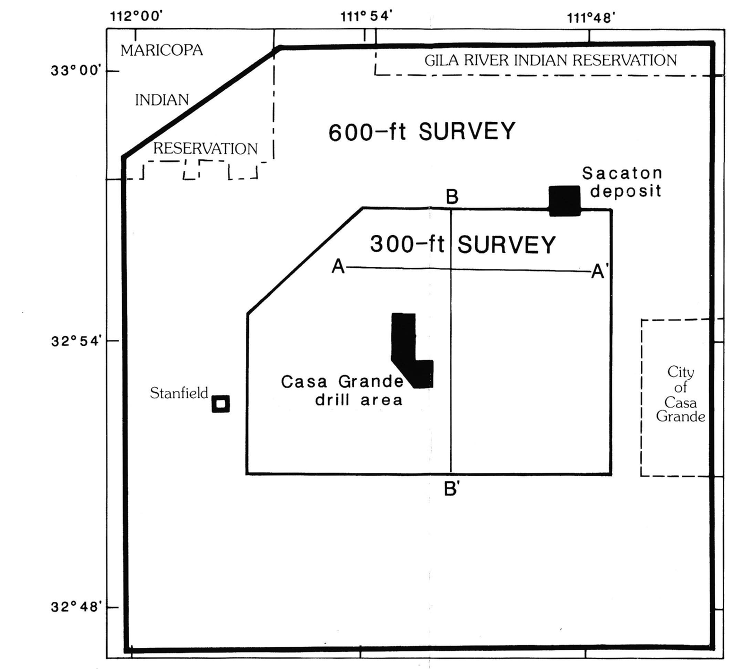

Figure 1.--Map showing the location of aeromagnetic surveys and the flight lines shown in figures 2 and 3.

The aeromagnetic surveys were flown May 7-8, 1988, by the USGS, using a fixed-wing aircraft. The altitude was radar controlled at a constant height above ground, and a Motorola Mini-Ranging System III navigation system was set up in the area to provide horizontal navigation coordinates. A GeoMetrics[1] model G-813 proton precession magnetometer was mounted in the aircraft tail stinger and had a sensitivity of 0.2 nanoTeslas and a cycle time of 0.8 seconds. The sampling interval was 0.2 seconds and average aircraft speed was 90 nautical mi/hour (46 m/sec). The magnetometer readings were corrected for time-dependant changes in the magnetic field, as measured by a base magnetometer set up in the field area.

The navigational data were reduced to a UTM coordinate grid having a central meridian of 117° W. longitude and a base latitude of 0°. The 300-ft (91-m) survey was gridded at a 0.062-mi (0.1-km) spacing, and the 600-ft (183-m) survey was gridded at a 0.124-mi (0.2-km) spacing, using a computer program written by Webring (1981) based on a minimum curvature algorithm (Briggs, 1974).

The International Geomagnetic Reference Field (IGRF), updated to May, 1988, was calculated for the appropriate latitude, longitude, and average survey elevation and was removed from each grid, using a program written by Sweeney (1990). The gridded data from the 300-ft (91-m) survey were contoured at a 5-nanoTesla (nT) interval (map A), and the data from the 600-ft (183-m) survey were contoured at a 20-nT interval (map B), using a program written by Godson and Webring (1982).

Two flight lines from the 300-ft (91-m) survey were repeated by two lines from the 600-ft (183-m) survey (two of these four flight lines are tie lines). Comparisons of these coincident lines are shown in figures 2 and 3, with total magnetic intensity shown in the lower profile and flight elevation shown in the profile above. Elevations for these profiles were calculated using a computer program (Bracken, USGS written commun.) that uses data from in-flight barometric and radar measurements and gridded terrain data. These profiles were calculated from original flight-line data and were not interpolated from the gridded data, and they qualitatively illustrate the quality and resolution of the two-level data.

AEROMAGNETIC MAPS

The aeromagnetic map of the 300-ft (91-m) survey (map A) shows a localized magnetic low, about 2 mi (3.2 km) in diameter, surrounding the drilled area, with a two-lobed, 20-30 nT high within the drilled area. A 15-nT high occurs 1 mi (1.6 km) northeast of the deposit. These anomalies are partially obscured by two steep, northeast-trending gradients from larger magnetic features: one gradient from the flanks of a 300-nT high located 2 1/2-mi (4 km) north of the deposit, and one gradient from the magnetic low originating in the basin southeast of the drilled area. The relative magnetic low in the drilled area appears to be an encroachment of lower values from the positive anomaly that shift the gradient farther to the northwest than would be expected. The source of this northeast-trending, high-amplitude positive anomaly is hidden below alluvium but is likely caused by a primary lithologic boundary in the basement rocks. Smaller anomalies in the study area are derived from intrusions, alteration, or basement relief.

To enhance magnetic features, especially shallow sources, of the 300-ft (91-m) survey, a "difference" map was produced by removing the higher-level, 600-ft (183-m) gridded data from the 300-ft (91-m) gridded data. The resulting grid (map C) has dual characteristics. The differencing method acts as a coarse vertical-gradient operator on long-wavelength anomalies caused by deep sources or shallow, high-contrast sources. By this method, the boundaries of the source of the magnetic low in the drilled area are outlined as a ring of highs (dashed line on map C). This ring probably encloses the major area of intrusion and related alteration that make up the Casa Grande deposit. The differencing method also acts to remove a regional field from the 300-ft (91-m) grid, enhancing residual, shallow-source anomalies measured only by the more sensitive 300-ft (91-m) survey. These short-wavelength anomalies probably represent a combination of shallow structural and lithologic variations.

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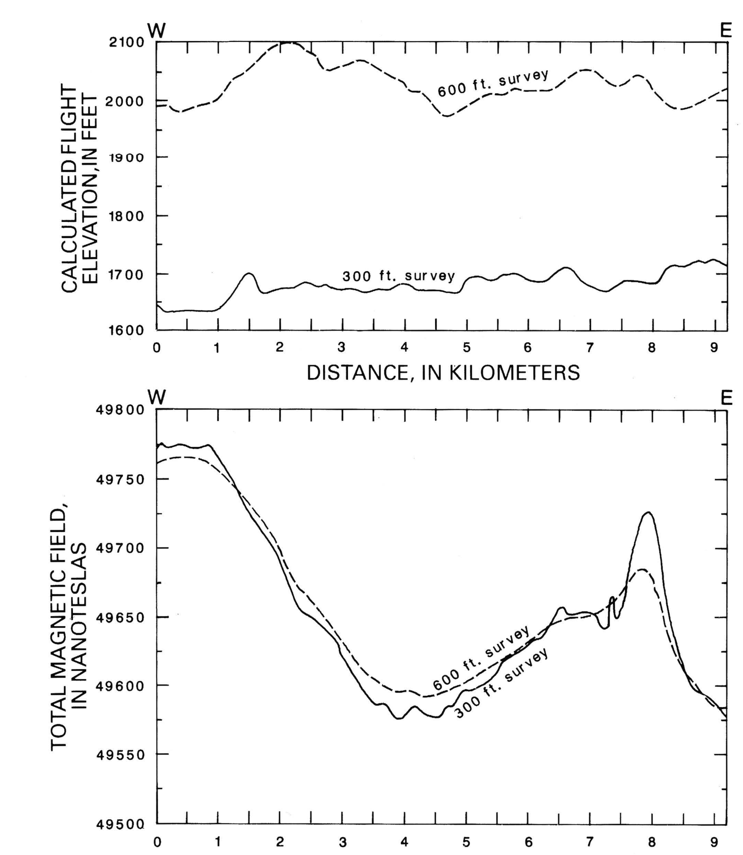

Figure 2.--East-west aeromagnetic profiles of line A-A'.

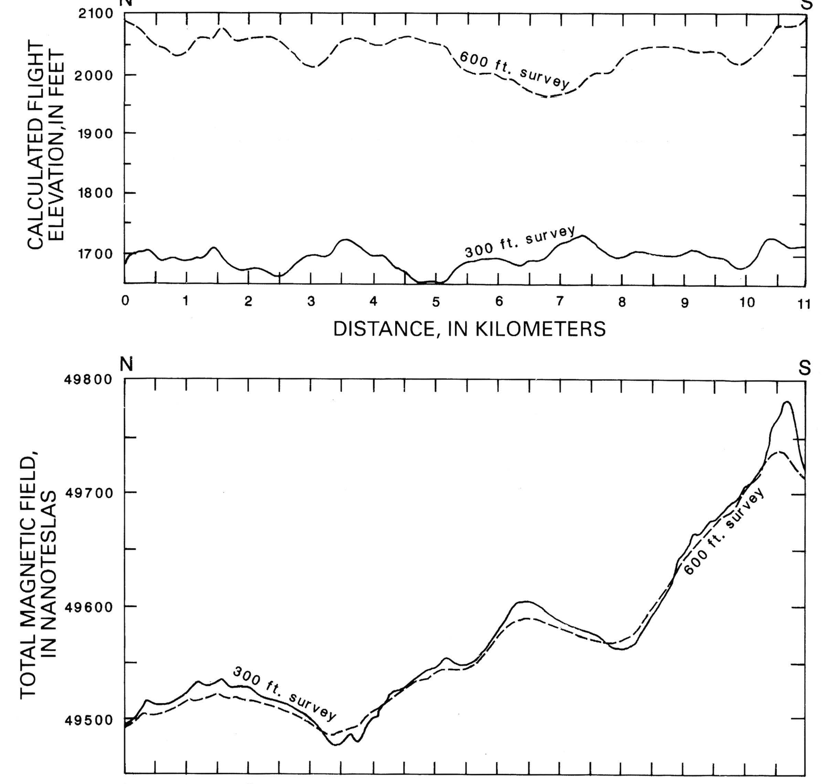

Figure 3.--North-south aeromagnetic profiles of line B-B'.

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